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Calcareous nannofossil biostratigraphy and geochronology of Neogene trench-slope cover sediments in the south Boso Peninsula, central Japan: Implications for the development of a shallow accretionary complex

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ABSTRACT

The geological structure and calcareous nannofossil biostratigraphy of the Middle to Late Miocene trench-slope succession in the southern Boso Peninsula, central Japan, were examined to obtain chronological constraints on the accretion and formation of the trench-slope architecture. As a result, trench-slope cover sediments (Kinone and Amatsu Formations) are clearly distinguishable from the Early Miocene Hota accretionary complex (Hota Group). The Hota accretionary complex was deposited below the carbonate compensation depth (CCD) and was affected by intense shearing, forming an east–west trending and south-verging fold and thrust belt. In contrast, the trench-slope cover sediments basically have a homoclinal dip, except at the northern rim where they are bounded by fault contact. They contain many species of calcareous nannofossils and foraminifers, which are indicative of their depositional environment above the CCD, and they show shallowing-upward sedimentary structures. Biostratigraphy revealed that the depositional age of the trench-slope sediments is ca. 15–5.5 Ma, suggesting that there is an approximately 2 myr hiatus beween the Miura Group and the underlying accretionary prism. Based on these results, the age of accretion of the Hota Group is inferred to be between ca. 17–15 Ma, and the group is covered by trench-slope sediments overlain on it after ca. 15 Ma. The timing of accretion and the age of the trench-slope basin tend to be younger southward of the Boso Peninsula. The accretionary system of the Boso Peninsula apparently developed in two stages, in the Middle Miocene and in the Late Miocene to Pliocene.

1. Introduction

The trench-slope basin is a sedimentary unit that is highly sensitive to subduction-related tectonics that preserves clues that provide understanding about the timing and processes of sediment accretion and the activity of plate boundary mega-thrusts or out-of sequence thrusts (e.g., Strasser et al., 2009; Moore et al., 2013). Landward inclination of bedding planes, depocenter migration in the same direction, and thrusting are all valuable indicators of a trench-slope basin phenomenon. Additionally, the basins preserve submarine landslide deposits formed due to trench-slope instabilities associated with increments of slope inclination (Yamamoto et al., 2007, 2012; Yamada et al., 2010; Strasser et al., 2011).

The geologic body exposed in the southern part of the Boso Peninsula, central Japan, represents young and non-metamorphosed accretionary complexes and their cover sediments. This system of accretionary prism and trench-slope basins in the southernmost Boso Peninsula was formed at ca. 7–4 Ma within a relatively short time interval (Yamamoto and Kawakami, 2005). However, the regional tectonics and accretionary processes older than 7 Ma in the south to central parts of the Boso Peninsula are not clearly documented. Although some trench-slope basin sediments are known in this area (e.g., Saito, 1992; Kawakami and Shishikura, 2006), the boundary between the trench-slope basin and the underlying accretionary complex is unclear because of their lithological similarity. Therefore, a key issue in clarifying this boundary is to establish the stratigraphy of the trench-slope basin overlying the Hota accretionary complex.

In the present study, calcareous nannofossil biostratigraphy was conducted to constrain the timing of accretion and development of the trench-slope basins in the central Boso area during the Middle to Late Miocene. The evolution of the Middle Miocene to Pliocene

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accretionary complex of the Boso Peninsula was then interpreted using biostratigraphic data from the present and previous studies (Saito, 1992; Yamamoto and Kawakami, 2005; Kawakami and Shishikura, 2006).

2. Geological setting

The sedimentary basins exposed in the Boso Peninsula are divided broadly into two groups by the Mineoka Tectonic Belt of the Honshu fore-arc. This belt has been interpreted as an ancient trench-slope break and divides the fore-arc basin from an oceanward sedimentary basin (Soh et al., 1991). Neogene sediments distributed in the northern side of the Mineoka Tectonic Belt are mainly belonging to the Hota, Miura, and Kazusa Groups (Mitsunashi et al., 1979). The Hota Group consists of sandstone, mudstone, and tuff deposited below the carbonate compensation depth (CCD) (Saito, 1992). The Miura Group, including the Kinone, Amatsu, Kiyosumi, and Anno Formations, consists of calcareous sediments and unconformably overlies the Hota Group (Mitsunashi et al., 1979). The sedimentary succession in the northern side of the Mineoka Tectonic Belt corresponds to the forearc basin sediments (Mitsunashi et al., 1979; Nakajima et al., 1981; Nakajima and Watanabe, 2005). The southern side of the Mineoka Tectonic Belt, including the central and southern parts of the Boso Peninsula, is composed of a basal accretionary complex (Lower Miocene Hota Group and Upper Miocene to Pliocene Nishizaki Formation) and trench-slope cover sediments (Middle to Upper Miocene Miura and Plio-Pleistocene Chikura groups) (Saito, 1992; Yamamoto and Kawakami, 2005; Kawakami and Shishikura, 2006). The trench-slope sediments of the Miura Group contain scoriaceous sand/pebble clasts derived from the Izu-Bonin island arc.

The origin of the Hota and Miura groups in the central part of the peninsula between the Sorogawa and Ishid faults (Fig. 1) has been discussed by some authors with regard to lithostratigraphic and chronostratigraphic correlations (Nakajima et al., 1981; Suzuki et al., 1990; Saito, 1992; Kawakami and Shishikura, 2006; Fig. 2). Nakajima et al. (1981) defined the Awa Group, with the Hota and Miura Groups, as being in stratigraphic comfomity in the eastern part of the Boso Peninsula, including the fore-arc side and accretionary complex area (Fig. 2). However, the Miocene to Pliocene succession around the south Boso Peninsula is characterized by an unconformity between the Hota and Miura Groups (Suzuki et al., 1990). Saito (1992) was the first to recocognize the Kinone Formation in the central Boso Peninsula. However, the lower limit of this formation is still unclear, and the formation itself has not been reported in the southwestern part of the peninsula. Additionally, Kawakami and Shishikura (2006) suggested the differentiation of the small trench-slope basin sediments composed of only the Amatsu Formation, named them the Minamiboso Group, and reported a Late Miocene age based on radioralian biostratigraphy. (Fig. 2). These inconsistencies originate from the lithological similarity of the Hota Group and the Kinone Formation. The formation names and stratigraphic relations in this study are based on Saito (1992) (Fig. 2).

3. Lithology and structure of trench-slope basin in the central part of the Boso Peninsula

In the study area, trench-slope cover sediments are exposed predominantly between the Sorogawa and Ishido faults (Fig. 1) (Kawakami and Shishikura, 2006). We note that the trench-slope sediments are distinguishable from the Hota accretionary complex by unconformities and relative degrees of deformation (Fig. 1). The Hota accretionary complex, which is distributed broadly in the study area, is characterized by intense shear deformation, east–west-trending and south-verging fold and thrust belts, and poor calcareous microfossils because the complex was deposited below the CCD. In contrast, trench-slope cover sediments are exposed sporadically along the Sorogawa Fault and other accretion-related thrust faults (Fig. 1). They consist of the Kinone and Amatsu Formations in this area and have basically homoclinal structures, except for the northern rim which is bounded by an east–west fault contact, and a high abundance and diversity of calcareous microfossils.

Sandy siltstones without scoriaceous grains correlated to the Kinone Formation unconformably overlie the Hota accretionary complex (Fig. 1). A basal conglomerate, composed of siltstone, tuff, and brecciated sandstone clasts, is developed in the basal part of the Kinone Formation (Fig. 3). The Amatsu Formation, composed of alternating beds of scoriaceous sandstone and siltstone, conformably overlies the Kinone Formation. In its upper part, the Amatsu Formation includes coarsening-upward facies and locally observed hummocky cross-lamination (Fig. 3).

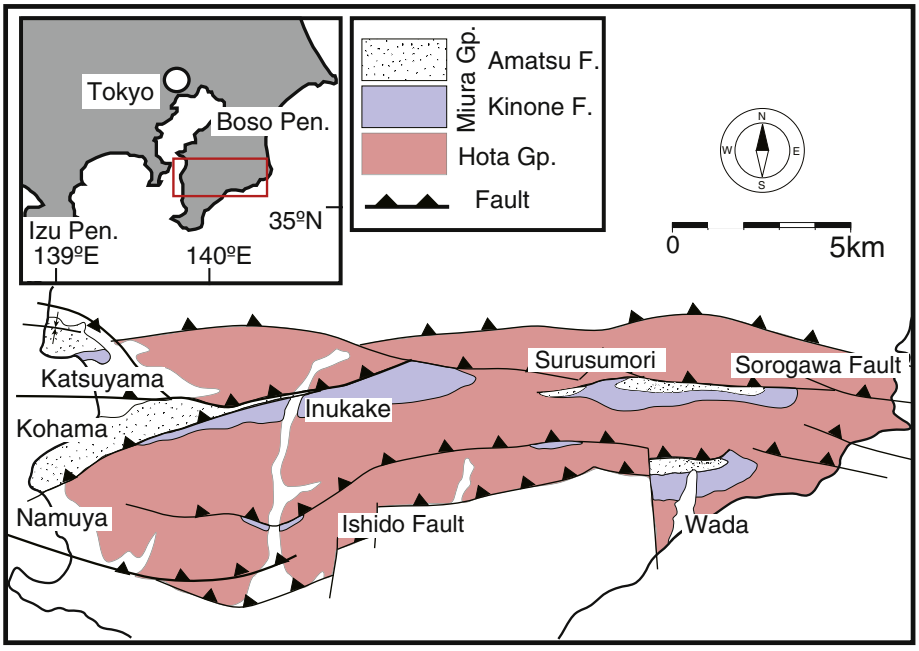

Fig. 1. Locality map and geological map of the southern Boso Peninsula.

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